

## Technical Memorandum

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**Date:** February 13, 2009

**To:** Ed Waddles, MTD Products Inc.

**cc:** Karen Crawford  
RMT Project Team

**From:** Robert Stanforth, Ph.D.

**Project No.:** 00-71360.27

**Subject:** Soil Stabilization and Solidification (S/S) Study  
Columbia Manufacturing Company (CMC), Westfield, Massachusetts

### Introduction

Soils at the CMC Westfield, Massachusetts site have been found to exhibit elevated levels of metals, volatile organic compounds (VOCs), and petroleum hydrocarbons. There is a concern that some of these constituents may be present at sufficient concentration that treatment to reduce their leachability is required. RMT, Inc. (RMT) has also determined that leachable metals at the site need to be below targeted remediation concentrations to achieve State of Massachusetts S-2 standards. Thus, a soil S/S study was conducted to evaluate various approaches to stabilizing site soils such that potential organics and metals would fall below their respective remediation target concentrations. In addition to stabilizing the leaching behavior of site soils, RMT also believes that it is desirable for the treated soils to exhibit a compressive soil strength that exceeds the United States Environmental Protection Agency's (USEPA's) treatment criteria of 50 per square inch (psi). Such solidification will better promote site redevelopment activities, extend the permanence of the remedy, and reduce groundwater seepage through the treated soil matrix.

### Approach

A 5-gallon bucket of soil was sent to RMT's Applied Chemistry Laboratory in Madison, Wisconsin for testing. Standing water was removed from the sample and a 2 Kg subsample was homogenized and prepared for S/S testing and evaluation. Compositional analysis and a screening-level Toxicity Characteristic Leaching Procedure (TCLP) were first conducted on the homogenized sample, with laboratory analysis conducted for the site-specific metals of concern. The S/S testing protocol consisted of evaluating the effects of introducing various amounts of Portland Type 1 cement (from 5 to 25 percent), and a mixture of Portland Type 1 cement (5 to 25 percent) and magnesium scrubber dust (MSD) (5 percent) to the soil sample. MSD acts both as a dewatering agent and as a source of heat to aid the cement in setting up in colder temperatures. The cement was mixed with water to an appropriate consistency prior to adding to the soil. The samples were mixed thoroughly, placed in sample containers (2 inch diameter by 4 inch length plastic cylinders), capped and then placed in a refrigerator at 5°C for

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curing. Refrigeration was utilized as an approximation of winter conditions that might be encountered in western Massachusetts.

Compressive strength measurements were made after one day and after 4 days using a pocket penetrometer. After four days, all the cement-treated samples exhibited pocket penetrometer readings that reflected maximum instrument deflection ( $>4.5$  tons/ft<sup>2</sup>, or  $>62.5$  psi). These samples were then sent, intact, to Pace Laboratories for Synthetic Precipitation Leaching Procedure (SPLP) leaching with analysis for various total petroleum hydrocarbon (TPH) carbon ranges. A sample of the untreated soil was also tested by Pace for TCLP metals, to confirm the results of the screening test.

## Results

### Compressive Strength

Pocket penetrometer readings for the samples after 1 day and after 4 days are shown in Table 1 (Attachment 1). After 1 day, the MSD-treated samples exhibited higher compressive strengths than their corresponding cement-only counterparts. However, by day 4, all the treated soil samples exhibited compressive strengths of  $>62.5$  psi. Note that these samples were cured at 5°C.

### Organic Leaching Characteristics

The treated soil samples were subjected to SPLP leaching (SW846 Method 1312), with analysis of the leachate for various organic carbon ranges, as well as for trichloroethene (TCE) and tetrachloroethene (PCE). The results are shown in Table 2 (Attachment 1).

All of the leachable organics evaluated demonstrated concentrations well below the remediation Target Concentrations for leachate (shown in Table 2). The untreated sample exhibited a SPLP leachate diesel range organics (DRO) concentration of 0.59 mg/L, versus a target concentration of 500 mg/L. The soil sample evaluated by RMT did not leach organics (either DRO, PCE, or TCE) above the target criteria. Thus, S/S treatment of these affected soils at the Westfield site would represent a conservative and effective measure of minimizing the potential for leaching of organics during the next phase of soil excavations anticipated at the plant.

### Metals Leaching Characteristics

Concentrations of cadmium, chromium, copper, nickel, and zinc leached from the soils during the TCLP tests (SW846 Method 1311) and the results are shown in Table 3 (Attachment 1). All the metals from these samples were well below the Leachate Target Criteria (shown in Table 3), with nickel the only metal above detection at 1.1 mg/L. The soil sample submitted for TCLP did not exhibit leaching characteristics that would require treatment to reduce metals leaching.

However, it has been reported to me that considerable variability exists in the organic and metals concentrations in the soils of this site and S/S treatment would represent a conservative and effective means of minimizing long-term environmental concerns for leaching potential.

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### Recommendations

In order to create a S/S soil matrix that would effectively reduce the long-term leaching potential of either organics or metals, RMT recommends an applied dosage of 5 percent Type I Portland Cement. The treated soil-cement matrix must then receive suitable compaction within the excavation to facilitate curing and development of suitable compressive strength. Laboratory test results suggest that the treated soil matrix will cure above a compressive strength of 60 psi within a matter of days, even when cured under cold (but not freezing) conditions. S/S treatment of these soils will effectively reduce the leaching potential of these soils for both metals and organics, reduce the potential for direct human exposure and contact, and minimize groundwater seepage through the treated soil-cement matrix. Such steps will effectively extend the permanence of this remedy and minimize concerns for long-term liability.

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### Attachment 1 Tables

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Table 1  
Strengths of Untreated and Treated Soils After 1 Day and 4 Days,  
Measured Using a Pocket Penetrometer

SAMPLE			STRENGTH (POCKET PENETROMETER) (psi)	
NO.	CEMENT (%)	MSD (%)	1 DAY	4 DAY
1	0	0	21	21
2	5		49	<62.5
3	10		59	<62.5
4	15		62.5	<62.5
5	20		35	<62.5
6	25		49	<62.5
7	0	5	35	35
8	5		56	<62.5
9	10		<62.5	<62.5
10	15		<62.5	<62.5
11	20		<62.5	<62.5
12	25		<62.5	<62.5

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Table 2  
Organic Concentrations in SPLP Leachates From Untreated and Treated Soil

SAMPLE		CONCENTRATIONS IN SPLP TEST LEACHATE (mg/L)							
		ORGANIC CARBON FRACTIONS – TPH						PCE	TCE
CEMENT	MSD	DRO					GRO		
		C08-C36	C10-C20	C10-C40	C20-C39	C10-C28	C05-C12		
0	0	0.65	0.55	0.66	0.085	0.59	<0.10	<0.001	<0.001
5		0.62	0.55	0.62	<0.049	0.58	<0.10	<0.001	<0.001
10		0.52	0.47	0.53	<0.052	0.49	<0.10	<0.001	<0.001
15		0.53	0.48	0.53	<0.049	0.49	<0.10	<0.001	<0.001
20		0.49	0.44	0.49	<0.053	0.46	<0.10	<0.001	<0.001
25		0.50	0.45	0.50	<0.052	0.47	0.112	<0.001	<0.001
0	5	0.60	0.55	0.61	<0.053	0.56	0.113	<0.001	<0.001
5		0.71	0.62	0.72	0.058	0.65	0.106	<0.001	<0.001
10		0.52	0.47	0.53	<0.051	0.48	<0.10	<0.001	<0.001
15		0.59	0.54	0.59	<0.052	0.55	<0.10	<0.001	<0.001
20		0.52	0.47	0.53	<0.052	0.48	0.103	<0.001	<0.001
25		0.57	0.51	0.58	<0.049	0.53	0.106	<0.001	<0.001
Criteria*	Carbon No	TPH	C5-C8	C9-C18	C19-C36	C9-C10	C11-C22		
	Type	-	Aliphatics	Aliphatics	Aliphatics	Aromatics	Aromatics		
	Value	500	5,000	5,000	5,000	5,000	500	0.7	0.5

The Criteria are from a memorandum prepared by Joyce Peterson (RMT, Inc.), dated January 27, 2009

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Table 3  
Metal Concentrations in Screening and Standard TCLP Leachates  
From Untreated Soil

METAL	LEACHATE CONCENTRATION (mg/L)		
	SCREENING TCLP	STANDARD TCLP	CRITERIA <sup>(1)</sup>
Cadmium	<0.0063	<0.25	0.4
Chromium	0.050	<0.25	5
Copper	<0.020	<0.25	900
Nickel	0.97	1.1	20
Zinc	0.43	<1.0	90

<sup>(1)</sup> The Criteria are from a memorandum prepared by Joyce Peterson (RMT, Inc.), dated January 27, 2009